JPRS L/10559

2 June 1982

West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 10/82)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

JPRS L/10559

2 June 1982

WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

(FOUO 10/82)

CONTENTS

ENERGY

LIGHT-WEIGHT PLASTIC BATTERY PATENTED BY FRENCH

Paris SCIENCE & VIE in French Apr 82 pp 75-77, 157

[Article by Anna Alter: "Long-Life Plastic Batteries"]

[Excerpts] With plastic storage batteries, the technique of battery manufacture has just made a leap forward. Created simultaneously in France and in the United States, they are five times as durable as their predecessors and lighter. But at first no one believed in them....

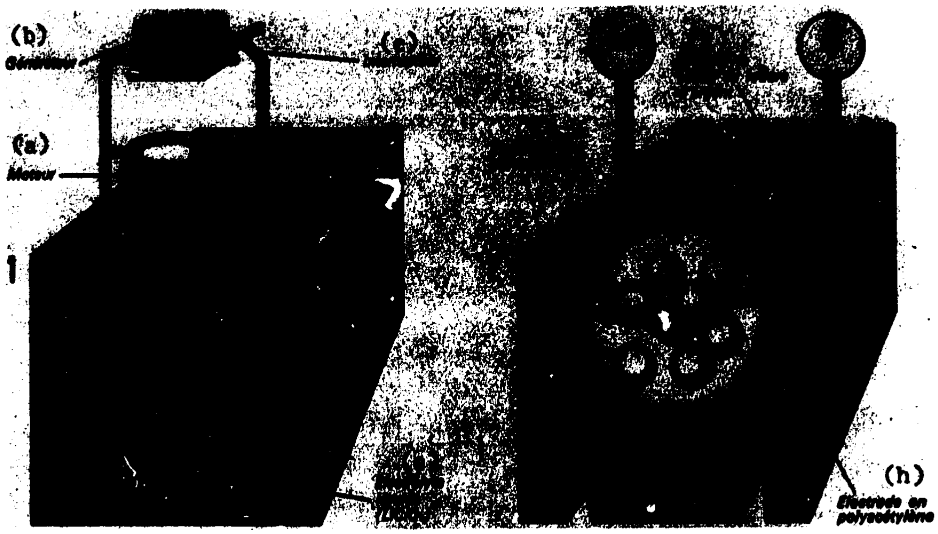
In March 1981 a patent for storage battery was applied for in the name of the CNRS [National Scientific Research Center] by Beniere, Franco and Louboutin. An hour earlier, universal time, American scientists at the University of Pennsylvania had also applied for a storage battery patent. The latter was received by the North American press as a great innovation in the area of electrochemical generators, or cells and storage batteries. The French invention, which is similar, only created a few echos.

It is true that each year there are dozens of patent applications for cells and storage batteries. They range from the improvement of a technical detail to the description of ambitious generators, some of which would probably have difficulty producing the slightest current. And it is true that none of these inventions has yet supplanted the inventions made over a century ago by Plante (lead storage battery in 1859) and Leclanche (dry cell in 1870) which cover almost the entire world market for electrochemical generators.

This is another matter. The invention mentioned above, French as well as American, is truly an invention. It is a completely plastic generator.

France-America: Ex Aequo

These two storage batteries have an ordinary appearance. Yet they have a characteristic that isn't: their electrodes are plastic (more precisely, polyacetylene), which should guarantee them a lifetime five times longer than that of their predecessors.



Key:

(a) Motor
(b) Generator
(c) Switch
(d) Polyacetylene electrodes
(e) Liquid electrolyte ($LiClO_4$)
(f) Polyacetylene electrode
(g) Solid silver iodide electrolyte
(h) Polyacetylene electrode

The first (1), which we shall call American because of its origin, operates according to Volta's principle: two electrodes are immersed in a liquid electrolyte (lithium perchlorate in propylene carbonate). When the switch is off, the direct electrical current from the generator passes into the electrolyte which produces its electrolysis, that is, the migration of positive ions (in pink here) through the electrolyte towards the negative electrode (in blue) and vice versa. Thus the two electrodes are "doped" and the cell is recharged. By turning the switch, the motor can then be supplied by the current produced by the cell.

The second (2), manufactured in France, operates on the same principle. However, it has an additional characteristic. This time, the electrolyte is no longer liquid, but rather solid. It is a silver iodide crystal (shaded balls in the inset). The mechanism of ion conduction can operate in this case because of the "defects" in the network formed by the ions, despite its greater rigidity. In fact, in every crystal there are defects called vacancies and interstitials (see article). That is why the ions can move by going in successive leaps from vacancy to vacancy or from interstitial to interstitial and, in this way, slip through (blue arrow). Since only the positive ions create the ion current in this system (in the first, a + and - exchange was necessary), the storage battery can operate (black arrows).

These "all solid" generators have the advantage of being absolutely leak-proof and can also operate in all positions, which is not the case with the American generators where the liquid electrolyte can spill. Francois Beniere, one of the coinventors of the storage battery, explains to us: "The Americans have applied for a patent for cells with liquid electrolyte, which is a handicap in my opinion, at least at the moment, since there is a risk of spontaneous reactions of the active materials A and B in the electrodes. For example, A can diffuse into the liquid and react without producing a current. That is what is called the phenomenon of self-discharge, which means that the cell wears out, even if it is not used (!...). On the other hand, our solid electrolyte keeps the atoms of the electrodes from mixing with each other and lets only the positive ions pass. This guarantee against self-discharge constitutes the real innovation of our cell, since all the cells sold commercially have a sales expiration date, like yogurt.... If you buy a cell today, you have to use it within a given time, since there is a phenomenon of slow degradation due to self-discharge. The cell from the Leclanche patent is a cell that wears out, even if it is not used, which is not the case with ours.

"The longevity of our cell," F. Beniere goes on to say, "will be 10 years from the date of manufacture. The longevity of dry cells is 2 years. The army, for example, is a great consumer of cells because, during maneuvers, cells are needed to operate transmitters, receivers, etc. Now, currently, it renews its stocks every 2 years, independently of use considerations."

Francois Beniere is proud to have ignored the skepticism that he encountered at first when he proposed to study a plastic storage battery. Subsequent events show that he was right. In addition to the Japanese, eternal rivals in all front-line research, a German company has assigned 40 specialists to work on this storage battery and, in the United States, 8 large firms are also interested in it.

The reasons for this lively interest are obvious. First of all, the price, which should be lowered because of simpler manufacturing processes and also because the polymer selected is cheap and easy to work. It can also be poured in sheets or compressed without notable problems, and the cells can be manufactured practically at ordinary temperature, while metals require high temperatures and a more complex, therefore costly, technology.

Then, there is convenience: the French storage batteries operate normally from -90°C to +120°C which makes them capable of operating at the poles as well as at the equator.

Finally there is its lightness, an obvious advantage that appears to be reviving the possibility of an electric car, at least in the long term. Sodium-sulfur-beta alumina storage batteries, by which it was once envisaged that lead batteries, which are infinitely too heavy for cars, could be replaced, require the melting of tens of kilos of sodium at 300°C which has attenuated the interest of industrial companies, to say the least. But there, F. Beniere is reserved.

For quartz watches, cameras, alarm clocks, cells capable of lasting 10 years (with recharging every 2 years and 20 milliamperes of current), plastic storage batteries seem competitive, with their lifetime and their quality more than compensating for a price higher than that of traditional cells. On the other hand, for operating an average car, F. Beniere estimates that a 20,000-ampere (A) battery would be required for a range of only 100 km. "Then," he says coolly, "you would have to provide a tavern, since recharging time at a current distributor is no less than 1 hour."

Given the fact that plastic storage batteries for watches, for example, have a current intensity of 0.1 A/hr, their performances must be increased by a factor of 100,000. "That is considerable," Beniere observes, "and I do not think that our 'all-solid' cells will get the electric car industry moving. We do not have the right electrolyte." As for the Americans' liquid electrolyte, it does not prevent self discharge, even if the battery is lighter. Nevertheless, the way seems less difficult. And we have probably not heard the last from the plastic storage battery.

9969
CSO: 3102/250

BRIEFS

COAL GASIFICATION: CHEMICAL FEEDSTOCKS--The executive council of CdF Chimie [French National Coal Board-Chemicals] recently appointed Pierre Durand to the newly created position of manager of the Carling plateau gasification project. This project covers construction of a gasification plant processing coal from Lorraine and its by-products (total output of 1.5 million tons per year). This plant will produce manufactured gas that can be used as raw material for numerous products, notably methanol and ammonia, or as a substitute for natural gas which can be fed into the GDF (French Gas Company) distribution lines or used as industrial fuel. For this reason, the studies already underway are being conducted jointly with GDF, EDF [French Electric Power Company], the Lorraine Basin Coal Mining Company, and with financial support from the Ministry of Industry. Engineering consultant firms are currently assisting in formulating plans for this project. A decision could be made by late 1982 or early 1983. Pierre Durand will also monitor feasibility studies for an ammonia plant using gasified coal and to be built in Mazingarbe. These two projects constitute one of the main courses of action in the CdF Chimie's strategy. Their implementation would contribute to optimum use of French coal resources through increased cooperation between CdF Chimie and the Lorraine Basin Coal Mining Company. It would assign a specific role to the Carling and Mazingarbe plants within France's chemical industry. Before being appointed to this high-level position directly under the CdF Chimie executive council, Pierre Durand was manager of the processes department in CdF Chimie's thermal directorate. As such, he contributed greatly to CdF Chimie's expanded work on polyethelenes, particularly with the recent development of an original process for making linear low-density polyethelene. Sumitomo, a Japanese firm, was recently granted a license to use this process. Pierre Durand is 43 and a mining engineer (Saint-Etienne School of Mining). [Text] [Paris SEMAINE DE L'ENERGIE in French 16 Mar 82 p 12] 8041

CSO: 3102/257

INDUSTRIAL TECHNOLOGY

MANURHIN TO CONSTRUCT FUJITSU-FANUC ROBOTS

Paris LE MATIN in French 7 Apr 82 p 4

[Article by Oliver Peretie: "Robotics: Manurhin To Sign Agreement With Fujitsu-Fanuc"]

[Text] A week before Francois Mitterrand's official visit to Tokyo, Fujitsy-Fanuc--a Japanese firm and the world's number-two manufacturer of industrial robots after Unimation, an American company--has announced it will soon sign an agreement with Manurhin, one of France's major machine-tool manufacturers. Initially, Manurhin will sell Fanuc robots. Then in January 1983, it will start building them under license.

For some time now, Fujitsu-Fanuc has stirred the imagination of French researchers and industrialists. Many of them have heard about the plant it had opened at the base of the Mount Fuji, a plant in which robots produce more robots. Fujitsu, the giant computer and telecommunications corporation, holds a 50-percent interest in Fujitsu-Fanuc. In just 6 years time, the latter has become the world's leading producer of numerical control systems, those "black boxes" that serve as automatic-control units for machine tools. It alone furnishes half of the world output of such systems.

The firm's very early interest in "smart" robots--those machines capable of guiding themselves--was a very logical development. Despite its dominant position in this advanced technology sector, robotics still accounts for merely 2 percent of the firm's total annual sales of 2.4 billion francs. But this figure is quite temporary because Fujitsu-Fanuc's annual rate of growth has been more than 50 percent since 1978. And the Japanese market for robots is growing at an even faster rate.

This then is the almost mythical partner that Manurhin's management sought and found. The Mulhouse company is one of France's leading machine-tool manufacturers. It also belongs to Matra. That nebulous corporation, headed by Jean-Luc Lagardere, actually owns 35 percent of Manurhin's capital stock.

Some 12 months ago, Paul Campbell-Tiegh, general manager of Manurhin-Automatic, the Alsatian firm's subsidiary and producer of its numerical control systems, opened negotiations with Fujitsy-Fanuc. These talks were recently brought to a successful conclusion. On 2 June, Seiuemon Inaba, president of the Tokyo firm, will arrive in Paris to sign the formal agreement.

As of this summer, Manurhin-Automatic will, therefore, begin selling the entire line of Fujitsu-Fanuc robots in France and then in Europe. As of January 1983, it will start manufacturing these robots under license. Its initial output will be quite modest inasmuch as the new production facility will employ only about 40 persons, or 10 percent of the company's present work force. Even though Paul Campbell-Tiegh declined to make the slightest forecast, it is almost certain that his company's number of employees and annual sales--150 million francs in 1981--will increase rapidly.

A few days prior to Francois Mitterrand's visit to Japan, Fujitsu-Fanuc has thus set a good example for well-designed Japanese-European cooperation. The Japanese firm has likewise found a graceful way of penetrating the European market without fear of protectionist reprisals. Nevertheless, this agreement could upset executives of Siemens, a German firm which is also a large supplier of numerical control systems. In addition, Siemens has business ties with Fujitsu in the large computer field.

Manurhin obviously did not deal with the Japanese without prior approval of the Ministry of Industry. Furthermore, Manurhin's action conforms to the wishes of DIELI (Electronics Industries Directorate) officials. These officials are convinced that France must move very quickly into robotics, because the technology will not wait for us to catch up. For this reason, the Alsatians quite simply sought that technology where it exists, namely in Japan.

8041
CSO: 3102/257

SCIENCE POLICY

GOVERNMENT TO ACQUIRE 51 PERCENT OF MATRA

Paris AIR & COSMOS in French 3 Apr 82 p 9

[Article: "Draft Agreement Between the Government and MATRA"]

[Text] The draft agreement signed on 18 March 1982 between the premier, Pierre Mauroy, and Jean-Luc Lagardere, chairman of the board of MATRA [General Mechanical Aeronautics Company, Propulsion Section], and settling the methods of state participation in the company's capital stock was approved by MATRA's board of directors on 24 March 1982.

Two distinct operations are covered by this draft agreement under whose terms the state will acquire 51 percent of MATRA's capital.

Public Exchange Offer by ONERA

ONERA [National Office for Aerospace Studies and Research] will make a public exchange offer involving 422,000 MATRA shares (that is, 25.5 percent of the group's stock). It will propose that stockholders exchange one share against a 15-year debenture with a face value of 1,800 francs (with interest payable from 1 January 1982),* it being understood that there will be a proportionate reduction in the ratio of the number of shares mentioned above with reference to the total number of shares exchanged in accordance with the regulations of the Stockbrokers Association. The offer will open on 13 April 1982 and close on 14 May 1982. The majority group indicated its decision to present all the stock that it controls in the PEO [public exchange offer]. The necessary steps will be taken so that MATRA stock may again be quoted on the stock exchange on 5 April 1982, a few days before the offer opens.

Increase in Capital Reserved for the State

An increase in capital reserved for the state involving 422,000 new shares with face value of 100 francs and issued at the price of 1,625 francs with interest payable as of 1 January 1982 is to be fully paid up at the time of subscription. This increase in capital will be submitted to the stockholders at the general meeting called for 29 April 1982. It will be available for

*The repurchase price initially proposed by the government was 1,215 francs per share.

subscription immediately following the closing of the PEO. The resolutions to be submitted to the general meeting also include the following:

--That the board of directors be made up of 12 members, 6 representing the government and 6 representing the remaining shareholders;

--That the bylaws conferring the right to two votes for each share nominally held by the same stockholder for more than 5 years be canceled.

The designation of the new board of directors will take place at the end of June 1982 but the special general meeting of stockholders called for 1500 hours at the Hotel George V in Paris will bring the present board of directors up to 12 members by nominating 4 persons put up by the government and whose mandate will take effect as soon as the increased capital is subscribed.

Results of Fiscal 1981

MATRA's board of directors, which met on 24 March 1982 under the chairmanship of Jean-Luc Lagardere, closed the company's accounts relating to fiscal 1981. The total sales (before taxes) came to 4,501 million francs (compared to 2,903 million in fiscal 1980). Net profit after taxes was 157.3 million francs after the creation of a special reserve fund to provide for the employees' profit-sharing plan (18.4 million francs), the assumption of the entire liability of the contingency fund for losses and expenses shown in the balance sheet as of 31 December 1980 (100 million francs), the write-off of losses sustained at the branches--automobile construction, electronics, clockmaking and watchmaking--both as regards funded allocations (141 million francs) and credits (185 million francs). At the regular general stockholders' meeting the board of directors will propose distribution of a 57-franc dividend (50 francs in fiscal 1980) plus capital gains of 28.50 francs. Estimates for total sales in 1982 come to 5.5 billion francs (before taxes), up by 22.2 percent over the previous fiscal year.

2662
CSO: 3102/222

TRANSPORTATION

SAAB-FAIRCHILD-340 PROJECT ENTERS PHASE THREE

Project Description, Schedule

Paris AIR & COSMOS in French 3 Apr 82 pp 15, 17, 64

[Article by Regis Noye: "Saab-Fairchild: An Effective Cooperation"]

[Text] Eight months after the prototype left the shop, the program of the American-Swedish SF-340 "commuter" plane, developed jointly by Saab-Scania and Fairchild Industries, has now come to maturity. Phase three of the construction, properly speaking, has been underway since November, at which time all the characteristics of the apparatus were established and its principal system and equipment chosen. Thus, the SF-340 is the most advanced of the five programs of commuter planes with seating capacity for more than 30 persons presently under development throughout the world, immediately followed by the Dash-8 of de Havilland Canada and the Brasilia of EMBRAER [Brazilian Aeronautics Company] (the other two being the ATR-42 and the Casa-Nurtanio-235). On the commercial level, despite a marked slowdown in sales felt for some months by Saab-Fairchild (as, moreover, by the competition) and attributed to the worldwide economic recession, the total number of orders has reached 116, of which 6 are options, or, according to the manufacturers, nearly 30 percent of the total sales obtained up to now by the 5 competitors (?). [Sentence as published]

In order to show the detailed progress of the work on both sides of the Atlantic, as well as the facilities developed in Sweden, Saab-Scania invited about 20 journalists of the international aeronautical press to Linkoping at the beginning of the week.

Let us first recall that the first agreement aimed at jointly developing a twin-propeller regional transport plane was signed by the two firms in June 1979 at the Bourget Exposition. The first phase of the program, consisting of the overall definition of the project during which the choice of motors was made, was completed in September 1980. The two parties had quickly agreed in their thinking and, a short time after a market study indicating that between now and 1994 there would be a worldwide need for 1,600 to 2,000 units of the chosen category, they decided on the official launching of the SF-340. Since then, the second phase, consisting of a detailed study of the equipment and necessary tooling, took a little more than a year, being completed last November when the first prototypes of the wings and fuselage made their appearance. Meanwhile, two important developments were made in June 1981: the choice of an entirely numerical standard form of avionics and rounding the bend on 100 orders. Since that time, the engineering mockup, constructed in wood at a scale of 1 to 1, has been serving only to finalize certain systems. It is to be noted that more than 60 percent of the general engineering of the equipment is attributed to Saab-Scania and that the two manufacturers are making considerable use of computer assisted techniques: 20 percent of the airframe and systems and 60 percent of the tooling were thus conceived.

The Saab-Fairchild-340 is noted for the importance attached to the economy factor resulting from the application of advanced techniques: modern General Electric CT7-5 motors (1,675 hp),; three-bladed Dowty Rotol propellers made of composite materials; assemblage of parts by gluing (aluminum on aluminum for subassemblies of the airfoil and fuselage; aluminum on honeycomb for the fins and stabilizers); the use of composite materials of sandwich construction (kevlar-kevlar for the motor shafts, the airfoil karmans, the ailerons, the mobile tall stabilizers; glass on glass for the radome. air inlets and cabin floorboard); numerical avionics (see page 19 of this edition) comprising five Collins cathode visualization instruments and a fuel control system. The economy factor is not only apparent in fuel consumption (45 seats per nautical mile per U.S. gallon* for 34 passengers, or at least 20 percent better than the old generation aircraft like the Fokker F-27-500), but also in maintenance. Thus, the SF-340 will be a craft which offers an extremely low DOC (direct operational cost), estimated, for example, to be less than 70 percent of that of the Gulf Stream 1, its principal competitor in the United States at present.

Let us recall at this time that the SF-340 is planned to appear in two versions: one called an "airliner" for the transport of 34 passengers (11 rows of 3 seats in front plus 1 row of 4 seats in the back at a distance of 30 inches); the other called an "executive" for business trips and having a capacity of 12 or 16 seats according to the chosen arrangement. Other versions are now being studied: for cargo or military use and with stretch-body configuration. Although Saab-Fairchild is not yet giving out any details on the latter, it nevertheless admits that its capacity will be limited to 50 passengers due to the chosen width of the fuselage (2.16 meters inside), permitting only 3 seats in front.

The performance and characteristics of the SF-340 have naturally changed since the beginning of the studies. Among the latter we note the following: a certain increase in weight (7,194 kg empty compared with 6,668 formerly; 11,794 kg on takeoff compared with 11,340), which means a slight decrease in the payload (3,239 kg compared with 3,311), and an increase in the length of the runway required for takeoff (1,175 meters compared with 1,082) and a lowering of the ceiling on one motor. On the other hand, the maximum cruising speed went from 480 km per hour to 507 km per hour and the distance which can be cleared with 34 passengers and IFR reserve went from 1,520 km to 1,670 km.

*Or 22 seats per kilometer per liter of fuel.

Distribution of Manufacture

On the production side, the distribution of workloads is 50 percent for each, value-wise. Fairchild Industries is responsible for manufacturing the airfoil and motor shafts as well as the tailfins; the American firm is also responsible for the fuel circuit and all that part of the hydraulic system which is integral to it, so that the fuel systems can come completely equipped from Long Island (New York). Moreover, they have assigned to their affiliate, Swearingen (Texas) the manufacture of the entire cabin arrangement and its components as well as their installation on the planes, which will be delivered to the United States. Saab-Scania, in turn, is building the fuselage assembly (divided in three sections) as well as the airfoil karmans. The final assembly will also take place in Linkoping. In this connection, the Swedish firm has invested 200 million Swedish krona in the construction of new installations with a surface area of 25,000 square meters, including a hangar 185 meters long by 35 meters wide by 12 meters high to house the assembly line comprising 12 work stations. Moreover, the new buildings house a machine shop, a surface-treatment shop and a gluing shop, the latter two having been operational since August. They have a large group of machine tools, representing 42 percent of the total investment, and many of which have numerical control. However, these new facilities might prove to be too narrow to house the preassembly bays (presently installed next to the Vari-Viggen assembly line) and the paint shop (not yet located). The first fuselage parts were manufactured in the underground facilities usually reserved for military programs....

First Flight in 10 Months

An initial series of 15 units has been under construction since November on one or the other side of the Atlantic. Although the upper and lower panels of the two initial fuselages are already waiting for final assembly, the side panels are in preassembly, while those of the following two (reserved respectively for static and fatigue tests) are being fastened together. The first tail fin will arrive in Linkoping in May and the first airfoil in August, when the final assembly of prototype No 1 will begin; this prototype is scheduled to leave the shop in November, and the first flight will be at the beginning of next year, followed shortly thereafter by No 2. Moreover, the CT7-5A motor is to begin its trials in flight, with the Dowty propeller, in August at General Electric's flight-testing facility (a Gulf Stream 1). The construction of a series of 10 motors is already underway with 6 units to be delivered this summer (4 for the two prototypes and 2 spare units), the first sample of the series not to be sent to Saab-Scania until 1983.

Certification of the SF-340 calls for 1,000 flight hours, which will be completed on the two prototypes by the end of 1984. Swedish confirmation will first be granted by the LFV [Swedish National Civil Aviation Administration] European [JAR 25 norms), then the American (FAR 25). At this point we may note that the total investment in the Saab-Fairchild 340 program is estimated at $100 million and that the total number of people employed in the program comes to 1,500, divided equally between the two firms.

Half of the Break-Even Point

On the commercial side, the 116 orders now on the books represent more than half of the program's break-even point, estimated at 200 units sold. The prime objective is to reach this figure before the first delivery. To do this, the organization put together by Saab-Fairchild is the following: responsibility for the North American continent (United States, Canada, Mexico) is assigned to Fairchild Swearingen (58 planes ordered, half of which are of the executive version); for Australia and Southeast Asia to the distributor, Stillwell Aviation (Sydney); for the rest of the world to the joint Saab-Fairchild HB affiliate, whose administration is in Linkoping with headquarters in Paris (58 planes sold, 6 being optional). One last word on the subject of the unit's price: $4.75 million for the airliner version, $5.5 million for the executive version (according to economic conditions of November 1981).

Cockpit, Avionics

Paris AIR & COSMOS in French 3 Apr 82 p 19

[Article by G.C.: "SF-340: Only Model With Cathode Instruments"]

[Text] Elsewhere in this edition we have given a detailed picture of the SF-340's cockpit and avionics system.

Obviously, the cockpit is designed for two pilots without a third man. It has five color cathode visualizations (Collins); two in the pilot and copilot areas (electronic ADI [Attitude Director Indicator] and HSI [Horizontal Situation Indicator]) and a fifth (optional in a central panel; the latter serves for the general presentation of navigational information, checklists and so on.

It will be noted that Saab-Fairchild is no longer proposing an "electromechanical" version for the principal flight instruments: the advantages of the cathode system in terms of reliability and maintenance costs (cost of ownership) appear to be attractive enough to make all users renounce conventional instruments. This simplifies the task of the engineering departments of the aircraft manufacturers.

With regard to the avionics system, the four principal cathode visualizations are fed by two conventional generators. These receive information from anemometric and cinematic collectors, particularly the behavioral power station, which is of the connected-components type, also Collins.

The upper panel is in conformance with the generally accepted principle: "if everything is extinguished, all is well."

Pilot visibility is good, in fact better than that recommended by document SAE580B.

With regard to suppliers, we note that Collins has the lion's share in this plane, particularly with the cathode visualizations, the automatic pilot assembly and the flight control--numerical--and the head and vertical power station with connected components.

Finally, it should be noted that Saab and Fairchild have retained certain French equipment suppliers for this plane:

--Sarma, which has just received a contract for cable tension regulators for the first 50 units with an option on the next 150.

--Jaefer: first order of more than 10 million francs for panel instruments (altimeter, anemometer, variometer--principal and standby).

--Sfena: 3-inch horizon standby gyroscopes.

--Saft, an order for 30 batteries in connection with this program.

8568
CSO: 3102/221

TRANSPORTATION

NEW APPLICATION COMBINES ROBOT, WATER-JET CUTTER

Paris AIR & COSMOS in French 3 Apr 82 p 35

[Article: "System of Robotized Water-Jet Cutter for Fiberglass, Charged Plastics and Composite Materials"]

[Text] Flow Systems, GmbH, Darmstadt, is introducing on the market a new application for industrial robots. The combination of an industrial robot with a water-jet cutter device results in a "Waternife" (patented), a flexible cutting tool of special attraction to the plastics industry, the automobile industry, the aerospace industry and defense industries. The cutting instrument is an extremely thin, steady water-jet, similar to a laser beam, made up of clear water at very high pressure (4,000 bars) and released at speeds reaching 1,000 meters per second. The jet is formed when water moves through an inexpensive synthetic sapphire. Nonmetallic materials such as plastics reinforced by fiberglass, charged plastics, especially composite materials with an aramide fiber base, even composite materials with a graphite base, may thus be cut at great speed without producing dust and with a good quality of cut surfaces.

The high-pressure water-jet raised to 4,000 bars is driven to the extremity of the robot through a combination of turning joints and spiral tubing.

The water pressure is intensified by a "Waternife" generator able to serve six robotized working stations.

The start-and-stop command of the water-jet is effected directly at the extremity of the robot by a single "Instajet" (patented) high-pressure start-and-stop vent making possible an instantaneous increase of pressure from 0 to 4,000 bars for piercing and the possibility of punching openings at any point in the material. All the command functions of the jet are integrated in the robot's command programs.

As a general rule, the industrial robot is an integral part of the "Waternife" water-jet system. This arrangement is designed to cut openings in the internal panels of automobiles in the plant of an important automobile manufacturer in the United States. Similar systems are now being tested for definitive evaluation in large European, American, and Japanese firms of the aerospace and automobile industries.

The "Waternife" cutting device may be fitted into the following industrial robots: Asea, Cincinnati-Milacron, Jobs, Kuka, Niko, Renault-Sybotech (Acma Cribier), and Unimation.

Robot equipped with a "Waternife" water-jet device, here seen cutting the interior panel of an automobile.

2662
CSO: 3102/222

TRANSPORTATION

FIRST FLIGHT OF AIRBUS A310 COMPLETE SUCCESS

Paris AIR ET COSMOS in French 10 Apr 82 pp 24-26

[Article by Jacques Morisset: "Airbus A310's First Flight Complete Success"]

[Text] The No 1 Airbus A310 made its first flight from Toulouse-Blagnac Airport on 3 April exactly as planned. The aircraft took off at 0633 GMT, i.e. 0833 local time, and landed 95 minutes later. Bernard Ziegler, Airbus Industrie's flight test and support director, told us that this initial flight had "met all of the preplanned test goals and even a bit more." Ziegler piloted the A310 with Pierre Baud as copilot. Three flight test engineers--Gunter Scherer, Gerard Guyot, and Jean-Pierre Flamant--also were on board to handle the test instrumentation and data monitoring duties. The aircraft's test equipment simultaneously measures 1,350 parameters. This equipment includes an airborne real-time computer. A telemetry system also enables ground personnel to evaluate some 10 structural parameters continuously and monitor traffic on the aircraft's intercom.

Takeoff weight was 122 tons. In addition to a partial load of fuel (34 tons), the aircraft carried 10 tons of flight test instrumentation plus water used as ballast because of the variations in the aircraft's center of gravity position (average of 25 percent in this first flight). Approximately 15 tons of fuel were burned during the flight which had been limited to an area bounded by Narbonne, Cahors, and the Pyrenees, thus remaining relatively close to Toulouse and within telemetry range.

Complete Success

The flightcrew considered this initial flight a complete success. Pierre Baud assured us that during the entire flight the FFCC [forward-facing crew cockpit] and its new systems "had functioned to perfection, living up to all our expectations. In other words, it made the crew's task easier and enhanced the aircraft's overall performance. There is no doubt that this is the result of the careful and meticulous preparatory work done earlier in a simulator and in actual flight in our own A300."

The new cockpit is optimized for use by a crew all of whose members are facing forward. Its equipment includes: push-button multifunction systems panels; electronic flight instrument system (EFIS) with cathode ray tube (CRT) displays;

an electronic centralized aircraft monitoring system (ECAM) with CRT displays of the status of aircraft systems during every phase of flight. Hence the FFCC is definitely the cockpit of tomorrow's generation of aircraft become reality.

Also noteworthy is the use of such new advanced technology systems as: status lights for control of spoilers, brakes, slats, and flaps; digital monitoring equipment for all systems, including the inertial navigation system; thrust controls; an automatic flight control system (CAVD) which includes a Category 3 automatic landing capability. All of the above are linked to a flight management system (FMS).

Bernard Ziegler told us that from the very first minutes of the flight "the crew had felt perfectly comfortable in this new environment. The same will certainly be true for all the crews that will soon be flying this aircraft. Never in all my previous experience have I found it so easy to open the gate to the future. I believe this is because of an imaginative but progressive policy of applying techniques designed to produce, without any risks to our customers, the constantly improved performance they require."

Ziegler also quickly listed what had been achieved during this first flight. We must say that this list is quite impressive considering the fact that this is a completely new aircraft making its maiden flight:

a. Evaluations of the flight envelope ranged from slow flight at a speed 1.1 times the stall speed to a maximum speed of 360 knots/Mach 0.77, and at a top altitude of 31,000 feet.

b. Flaps, slats, and landing gear were first tested in five configurations: 15-degree flaps and slats on takeoff, then landing gear retracted, then flaps retracted, then slats retracted. The crew then tested takeoff configurations with 20-degree flaps and 15-degree slats; holding pattern with (solely) 15-degree slats; landing with 30-degree slats and 40-degree flaps. Lastly, large angles of attack were tested up to 17-degree effective angle of attack (stalling should occur at about 21 to 22 degrees).

c. All aircraft "systems" performed well, including, of course, the Pratt and Whitney JT9D-7R4 engines and all flight control aids (autothrottle, yaw damper, etc.), the brakes (fully set), etc. No significant problems were encountered, but this first flight did indicate the advisability of modifying the coordination (roll-pitch) "gains" and reducing the artificial feel system about 20 percent. This will be done for the second test flight. In fact, the A310's overall performance is already nearly perfect.

d. Performance evaluations were made at two flight levels: 25,000 feet and 31,000 feet. The initial findings are that the aircraft performed as predicted.

e. The on-board Garrett APU [auxiliary power unit] was put into operation on the ground to start the aircraft engines. It ran during the entire flight. In fact, "it was forgotten." The landing gear and brakes were completely satisfactory, and so were the thrust reversers (employed at full capacity for this first landing). In fact, only one system problem was encountered: one of the two computer channels in the fuel quantity indicator system malfunctioned.

f. Special mention must be made of Sfena's automatic flight control system (CADV). Its two digital autopilots were used quite extensively during, for example, performance evaluation in cruise. All modes were employed, including new modes such as the "change of level." The first approach was a CADV-coupled approach to an altitude of 700 feet.

Lastly, the crew reported they had felt they were flying in "an already familiar aircraft." This "familiarity" is the result of 10 years of work and close cooperation not only between the various participants in the Airbus program but also between design offices and the test pilots and flight test engineers. It will be recalled, in this connection, that the test pilots and flight test engineers participated in the development of the new aircraft and its cockpit, thereby giving the A310 benefit of experience gained not only in developing the A300 but also in placing the aircraft in service in each customer airline. Aitbus test pilots and flight test engineers do not merely work at Toulouse. In fact, when new aircraft are delivered to an airline, they regularly assist that customer in entering the aircraft into service on its route network. Of course, the work done earlier in the simulator and on No 3 Airbus [testbed aircraft]--systems, digital autopilot--were especially beneficial.

As of early this week, the A310's second test flight is scheduled for 8 April. It will be used to open the flight envelope even more, thanks to the first flutter measurements (by means of "flutter vanes"). Other planned test goals include flying with asymmetric thrust, evaluating the aircraft's manual handling qualities, and making the first in-flight engine restarting tests.

The test program will focus on three principal tasks during several dozen hours of flying over the next few weeks: complete performance evaluation in cruise and on takeoff, and stall tests. Bernard Ziegler hopes to be able to accomplish the major part of this work in only 1 month.

The second A310 is expected to begin flying on 6 May. Then in late July or early August, a third A310--fitted with General Electric CF6-80A engines--will participate in the basic flight program. It is already apparent, however, that the A310 is a successful aircraft. Its first flight had an exceptional number of test goals and the A310 lived up to the expectations of all European manufacturers involved in the program. It also further enhanced the Airbus consortium's credibility with respect to its development of the future A320 transport.

A310 Sales

Airbus Industrie has officially received a total of 180 A310 orders to date: 90 firm orders and 90 options. Following is an alphabetical list of the 15 airline customers (the selected engine manufacturer is shown in parentheses): Air France, 5 firm orders plus 10 options (GE); Austrian

Airlines, 2 plus 2 (PW); British Caledonian, 3 plus 3 (GE); Cyprus Airways, 2 (GE); KLM, 10 plus 10 (GE); Kuwait Airways, 8 (PW); Lybian Arab, 6; Lufthansa, 25 plus 25 (GE); Martinair, 3 plus 1 (GE); Middle East, 5 plus 14 (PW); Nigeria Airways, 4 plus 4 (PW); Sabena, 3 plus 3 (PW); Singapore Airlines, 20 options (GE); Swissair, 10 plus 10 (PW); and Wardair, 6 plus 6.

These 15 customers will be joined by the Brazilian airline VASP which has already ordered three A300B2-200 transports powered by General Electric engines and has decided to purchase at least six A310's. When this Brazilian order is officially announced, Airbus Industrie will have 186 A310 orders from 16 airlines.

Headquarters Expansion

Although Airbus Industrie's number of employees--approximately 1,000 persons--is only slowly increasing--the goal is to remain a "light" organization--the growing number of airline customers has, nevertheless, compelled the consortium to augment its technical support teams to ensure their continuous availability to each Airbus user. An extensive construction program is underway at Toulouse. It is designed to triple the headquarters' working area (an expansion of 13,500 square meters). Hence there will eventually be some rearrangement of certain departments. The consortium partners currently have about 20,000 employees working on Airbus transports. By 1985, they will number 40,000 to 45,000.

8041
CSO: 3102/256

TRANSPORTATION

VOLKSWAGEN AUTOMOBILE ENGINES FOR ALCOHOL FUELS

Stuttgart MTZ MOTORTECHNISCHE ZEITSCHRIFT in German Mar 82 pp 91-95

[Article by Gerd Decker and Holger Menrad]

[Excerpts] Summary

Based on earlier research work different concepts for the use of alcohol fuels, especially methanol fuel M 100, were developed in the Research Division of VW.

More than 150 VW vehicles for M 100 fuel are joining different test programs in Germany and California; technical information about the vehicle concepts is given in Table 2.

The engines of these vehicles differ from standard gasoline engines mainly by higher compression ratio, modified combustion chamber and intake manifold, adapted carburetor or injection system and material changes for alcohol compatibility.

The maximum power output of the methanol engines is about 20 percent higher than that of comparable gasoline engines, energy consumption is 10 to 15 percent less. Problems of preignition and high-speed knocking at full-load operation require throttling of maximum power output. Exhaust emissions are lower than the actual standards, Table 4, drivability and cold starting down to -20°C is satisfactory.

The U.S. concepts, consisting of methanol and ethanol fueled vehicles, are equipped with a fuel injection system calibrated for alcohol operation with feedback control and a three-way catalyst. These concepts conform also to existing emission and economy standards, Table 5.*

*The work was in part supported by the Ministry for Research and Technology. Thanks is hereby expressed for that support. The authors are grateful to the staff workers in Energy Technology Research and New Technologies for their valuable assistance.

1. Previous Testing Programs

Several years ago prototypes and individual experimental vehicles, respectively, to operate on alcohol fuels, especially methanol, were produced. The vehicles were subjected to extensive studies and tests. (1, 2, 3] From these experiences a methanol fuel was developed which consists of up to over 90 percent methanol (M 100). In contrast to this there are the methanol-gasoline fuel mixtures, as for example "M 15" which have only 15 percent methanol. Using the experiences of previous prototypes as a basis, M 100 vehicles were manufactured under series production conditions in the VW factory.

Manufacturing vehicles under series production conditions provides additional experiences about the kinds of production to be expected in actual practice. The vehicles produced in the VW factory in Wolfsburg are being utilized in the FRG and West Berlin within the framework of the demonstration and research program "Alternative Energies for Road Traffic, Alcohol Fuels Project Group," which is being supported by the Ministry for Research and Technology [BMFT]' these are in addition to others which are intended for methanol-gasoline fuel mixtures "M 15" or alcohol-diesel fuel mixtures. [4] In the meantime additional vehicles were delivered to several European and overseas countries for further tests.

In summer 1981, in the Westmoreland Factory of Volkswagen of America, the first vehicles were manufactured in a model series, likewise under conditions of series production. These vehicles are destined for a California Energy Commission test program which will run for 2 years in California in the United States.

The vehicles which are produced in the FRG and the United States and which are the subject of the following report are intended to operate on methanol fuel and conform to today's high technical standard of automobile technology which is normal in these countries. Vehicles which have been in production for a rather long time in Brazil are designed to operate on ethanol fuel.

2. Characteristic Values of Fuels

The vehicles are adjusted to use methanol fuel (M 100) in accordance with Table 1, reprinted from [5]. This fuel consists primarily of methanol, to which isopentane is added as a low-boiling component. With that, the vapor tension of the methanol fuel is specified to the upper limit of corresponding gasoline engine fuels according to DIN [German industrial standard] 51 600 for summer and winter operation, respectively. With these vapor tension values and the associated raising of the lower boiling range it is possible to have problemfree cold starting in the vehicles with winter fuel at temperatures as low as -20°C without additional components in the vehicle engine design. The fuel of this specification is satisfactory not only to meet the demands for cold starting, but also for perfect driving behavior in the engine's hot running phase. This is true both of injection engines and of carburetor engines which are more difficult to control in this phase.

The isopentane which is added to the methanol can, if need be, be replaced by other easily volatilized components, as for example dimethyl ether. Of course, for this fuel a new adjustment of the fuel mixing equipment is necessary both in the air requirements and in the hot running equipment. Since we have had the most experience so far with isopentane and working with it is relatively simple, this additive component was uniformly scheduled for test projects presently in progress.

Compared with gasoline engine fuel which is standard in the trade the methanol fuel utilized here has lower air requirements and a clearly lower calorific value. This requires complete modification and readjustment of the fuel mixing equipment both in the carburetor and the injection systems. Even the substantially higher heat of evaporation is a contributing factor in laying out the design.

Pure methanol does, of course, have the prerequisites for a fuel which is suitable for gasoline engines, but only after suitable components have been added does it produce a methanol fuel which satisfies the requirements of a modern engine fuel. In addition to the easily volatilized component, which was already mentioned, the fuel should contain further additives to avoid corrosion in the fuel mixing system and to avoid deposits in the intake system.

This means that a methanol fuel must be adapted in the same way to the requirements of the vehicle engine design that we take to be a given in the case of today's gasoline engine fuels with the appropriate additives.

3. Design Development

For the development of the VW design vehicles it was possible to build on the development of basics from previous years. This produced the following essential aspects for designing the engine:

--In adjusting the fuel mixture considerable value was placed on minimum consumption. This means that in the partial load range air values up to 1.2 were sought. On the basis of the favorable ignition range, in driving behavior the engine can be operated leaner than comparable gasoline engines, without misfires and defects. For maximum full load power air values between 0.9 and 0.95 are required.

--In the case of highly compressed alcohol engines the necessary preignition values are lower than in the comparable series produced gasoline engine with normal compression.

--The high octane numbers of methanol fuel permit compression ratios between 12 and 13 which promises favorable partial load consumption and high mean effective pressure with full load operation.

--The high sensitivity of the fuel (difference between ROZ [research octane number] and MOZ [engine octane number]) results in a strong temperature influence on the knock limit. With consideration of high external temperatures the safety distance from the knock limit must be greater than is necessary in normal engines for gasoline engine fuel.

--Since methanol engines with high compression easily tend toward unwanted preignition (premature ignition), this must be taken into consideration in appropriate combustion chamber design and careful adjustment of spark plug construction type and spark plug thermal value.

--The high heat of evaporation of the fuel requires careful adjustment of the fuel mixing equipment and regulation of cold starting and hot running.

--Moreover, the emission behavior must be taken into consideration. Because of the high compression, higher HC emissions must be figured on whereas by the choice of the ignition point the NOx emissions can be kept roughly on the scale of comparable low-compression gasoline engines without consumption losses.

The engine designs for these vehicles were done in such a way that the most favorable partial load consumption had the highest priority. In adjusting full-load operation, high-speed knocking and preignition of the mixture produced limits. Since the temperature level of the engine has a strong influence on this limit, careful adjustment was necessary. [3]

However, this means that the maximum achievable highest power with the necessary operation safety cannot be guaranteed in all cases. Thus, the engines are throttled at full load.

The mixture formation calls for intensified mixture heating for carburetor engines by means of a newly designed manifold inlet and increased preheating of the air.

The compression ratio and the shape of the combustion chamber were designed according to the criteria mentioned here, partial load consumption, power and emission behavior. [6] Moreover, it became apparent that the cold start behavior had to be taken into consideration in designing the combustion chamber since alcohol engines easily, because of their relatively high proportion of fuel in the mixture, tend to get the spark plugs wet. This problem was a contributing factor in the design of the combustion chamber and the positioning of the spark plugs.

All parts of the vehicle engine design which come into contact with the fuel were reworked in respect to the choice of material in order to avoid damage through the impact of methanol in the case of elastomers and plastic parts and to prevent corrosion in the case of metal materials.

From available VW Audi models three vehicle types were selected for the research and demonstration program mentioned and were adapted to operate on alcohol fuel. Series-like units were the point of departure in developing these designs. Table 2 gives the technical data of the three designs.

4. Selected Vehicle Types

4.1 The VW Golf with Water-Cooled 1.6-Liter Carburetor Engine

Figure 2 shows the combustion chamber design which was selected according to the above-mentioned criteria. The four-cylinder in-line engine has a compression of 12.5.

The reworked fuel mixing system includes the new design of a water-heated manifold inlet with intensive heating of the fuel-air mixture behind the carburetor. In addition, in contrast to the series produced version, the water jacket was enlarged to the extent space permitted. With this design higher manifold inlet temperatures and thus good mix preparation and distribution were achieved in the partial load range, as was rapid warming of the mixture after a cold start.

Adjustments on the 34 PIC(T)5-carburetor from the Pierburg Co were impressive in scope. In contrast to the basic carburetor for gasoline operation, numerous changes were required; the main ones concerned the jet equipment, the use of methanol-resistant materials (gaskets, floats), including surface protection of the carburetor housing and the adjustment of the starter (hand choke).

To guraantee driving behavior with critical operating conditions and an engine not hot from running, the engine was equipped with electronic high-power ignition (TSZ). This ignition system also contains digital idle stabilization (DLS) for sure idling, even with a lean engine setting.

All these measures proved to be advantageous in achieving faultless driving behavior and favorable partial load consumption; of course, in the full load range there are limits because of knocking.

All Golf vehicles were equipped with a larger tank so that there is roughly the same range as in the case of gasoline vehicles.

4.2 VW Golf with Water-Cooled 1.6-Liter Fuel-Injection Engine

In respect to the combustion chamber and ignition, the injection design corresponds to the carburetor design. Additional measures for heating the intake air or mixture were, nevertheless, not undertaken in this design.

The K-Jetronic was likewise adapted to the altered fuel characteristics; special importance was also given here to cold start and hot running behavior.

In this version of the design with increased power, the maximum possible mean effective pressure with full-load high speeds is limited not by high-speed knocking, but by unwanted preignition.

Since the engine with injection shows higher power than the carburetor version used here, the temperature level of the cooling water was lowered because of the high sensitivity of the fuel in order to avoid high-speed knocking and undesired preignition.

4.3 The VW Transporter with Air-Cooled 2.0-Liter Carburetor Engine

Because of its unusually low stroke-bore ratio of 0.75, with consideration of the combustion chamber design, the air-cooled 4-cylinder opposed cylinder type engine permits a compression of only 10.5.

The design was carried out in a manner analogous to the Golf carburetor design. For this type new manifold inlets with electric heating by PTC elements were developed. Thus, with a cold engine it was possible to achieve clear improvement in driving behavior.

5. Results of the Experiments

5.1 Power

Experiments on prototypes have shown that with optimized methanol engines increases in power of over 20 percent are achievable in respect to comparable gasoline engines. There are reports in [7] on studies of the temperature curve on pistons as an example of component stress; the results show that no critical thermal conditions are present.

5.2 Partial Load Fuel Consumption

In contrast to the comparable gasoline engine the methanol engine shows roughly 10 to 15 percent more favorable consumption values with full load, when compared on the basis of the energy, with consideration of the different calorific values of the fuels.

For the designs previously described the values cited in Table 3 came from consumption measurements made according to DIN 70030; when compared to gasoline vehicles these values are about 10 percent lower.

5.3 Emission of Pollutants

It was a precondition for all designs that the emission limits according to ECE regulations are met. For the carburetor design previously described the values shown in Table 4 were measures in the ECE test.

Analyses of tests show that with a hot engine the emission values are more favorable than those of the gasoline engine, while in the warm-up phase the values are roughly comparable.

There are only isolated values so far for the increased emission of aldehyde in the case of pure alcohol engines. However, an extensive experimental program is in progress in this area.

Several of the vehicles utilized in the BMFT program were equipped with special exhaust gas catalysts to reduce the emission values; at regular intervals measurements were made.

5.4 Practical Drive Testing

With winter tests sure starting up to -20°C was achieved with the designs previously described. [8] Summer tests produced no problems in hot starting and hot drive behavior since in the fuel system lower temperatures occur than with gasoline or M 15 operation.

The 80 VW vehicles provided for in the BMFT program have since been delivered to the operators. Some 25 vehicles were put into service by the ADAC [General German Automobile Club] for road maintenance service; some of these vehicles have gone more than 50,000 km to date without any breakdowns worth mentioning.

5. Alcohol Vehicles in the United States

In California at present an extensive experimental program is being carried out with alcohol vehicles. Operator of the fleet is the California Energy Commission, the vehicles are maintained by Alcohol Energy Systems Inc, Santa Clara.

In all, in July 1981 in the Westmoreland VW factory, a first series of 40 vehicles of the Rabbit type (U.S. version of the Golf) and Rabbit Pickup were built under series-production conditions. The vehicles were delivered to the operators in September 1981. One-half of the vehicles is operated on methanol fuel corresponding to the specification in the German program, the other half with ethanol to which was added 5 percent by weight leadfree gasoline. With the ethanol design cold starting requires extra gasoline that has been injected into the manifold inlet.

The basis of both designs was the previously described fuel-injection design. The most substantial change consists in the use of the K-Jetronic adjusted to methanol and ethanol operation, respectively, with a lambda sensor and the use of a selective catalyst in the exhaust system. All vehicles are equipped with series-produced automatic transmissions.

The measurements on the prototypes produced the emission and consumption values which are shown in Table 5.

BIBLIOGRAPHY

1. Menrad, H., Lee, W. and Bernhardt, W., "Development of a Pure Methanol Fuel Car," SAE 770790.

2. Oblaender,K., Abthoff, J. and Nagel, B., "Methanol as an Alternative Fuel for Gasoline Engines," ATZ, Vol 78, No 3, 1976, pp 113-117.

3. Menrad, H., "Vehicle Prototype for Methanol Drive, Lines of Development in Vehicle Technology," in Fourth Status Seminar "Vehicle and Road Traffic Technology" from the BMFT, 10-12 November 1979, Berlin.

4. Menrad, H., "The Part of Volkswagenwerk AG in the German Program for Research on Alcohol Fuels," in "75th International Automotive Progression Systems Symposium," 14-18 April 1980, Dearborn, Michigan.

5. Keim, K. H. and Mueller, H., "Methanol Fuel M 100--Development and Technology," in 8th Status Seminar "Vehicles and Road Traffic" of the BMFT, 11-13 November 1980, Malente.

6. Menrad, H. and Loeck, H., "Results from Basic Research on Alcohol Powered Vehicles," in "Fourth International Symposium on Alcohol Fuels Technology," 5-8 October 1980, Guaruja, Brazil.

7. Latuske, Lingenhoelin, "Thermal Stress of the Piston with Use of Alcohol and Mixed Fuels," MTZ, Vol 43, No 3, 1982, p .

8. Nierhauve, B., Menrad, H. and Decker, G., "Testing of Methanol Fuels at Low Temperatures," ATZ, Vol 82, No 11, 1980, pp 579-583.

Authors' Addresses:

Gerd Decker, Graduate Engineer
Alte Braunschweiger Strasse 10
D-3180 Wolfsburg 14

Holger Menrad, Graduate Engineer
Haldensleberstrasse 5
D-3180 Wolfsburg 14

Table 1. Specification of Methanol Fuel M 100 in the Large-Scale BMFT Experiment

				(1) Spezifikation	
				(2) Winter	(3) Sommer
(4)	Methanol	(19) Gew.-%	ca.	91.5	94.5
(5)	Isopentan	Gew.-%	ca.	8.5	5.5
(6)	d_{15}	g/cm^3	ca.	0.779	0.785
(7)	Dampfdruck	mbar	ca.	900	700
(8)	Heizwert	MJ/kg	ca.	21.98	21.35
(9)	Wassergehalt	ppm	max.	1000	1000
(10)	Abdampfrückstand	mg/l	max.	10	10
(11)	Methylformiat	ppm	max.	5	5
(12)	Ameisensaure	ppm	max.	10	10
(13)	Alkalität	ppm	max.	1	1
(14)	Gesamtsäure	ppm	max.	20	20
(15)	Trübungspunkt			- 50° C*)	
(16)	ROZ		ca.	114	114
(17)	MOZ		ca.	94	94
(18)	*) bei 10 Gew.-% H_2O-Zugabe				

Key:
1. Specification
2. Winter
3. Summer
4. Methanol
5. Isopentane
6. d_{15}

[Key continued on following page]

7. Mean effective pressure
8. Calorific value
9. Water content
10. Residue from evaporation
11. Methyl formate
12. Formic acid
13. Alkalinity
14. Total acid
15. Turbidity point
16. Research octane number
17. Engine octane number
18. *) with 10 percent by weight H_2O added
19. Percentage by weight

Table 2. Data of the VW Designs Used in the BMFT Program

	Golf (1) Vergaser	Golf (2) Einspritzer	Transporter
Zylinderzahl (3)	(13) 4 Reihe		(17) 4 Boxer
Kühlung (4)	(14) Wasser		(18) Luft
Hubraum cm³ (5)	1588		1970
Hub mm (6)	80		71
Bohrung mm Ø (7)	79,5		94
Verdichtungsverhältnis (8)	12,5		10,5
Motorleistung (9) kW(PS) bei l/min	63(85)/5600	81(110)/6100	51(70)/4200
Zündung (10)	(15) TSZ + DLS	TSZ	(19) TSZ + DLS
Kerzen (11)	W4C1 (W260T2)		W4C1 (W260T2)
Gemischbildung (12)	(16) Vergaser 34 PIC(T)-5	K-Jetronic	(20) Vergaser 34 PDSIT

Key:
1. Carburetor
2. Injector
3. Number of cylinders
4. Cooling
5. Displacement cm^3
6. Stroke mm
7. Bore mm ϕ
8. Compression ratio
9. Engine power kW (hp) at liters/min
10. Ignition
11. Plugs
12. Mixture formation
13. 4 in-line
14. Water
15. High-power ignition + digital idle stabilization
16. Carburetor
17. 4 cylinder opposed arrangement
18. Air
19. High-power ignition + digital idle stabilization
20. Carburetor

Table 3. Fuel Consumption Values According to DIN 70 030

	(1) Stadt	90 km/h	120 km/h	(2) Misch-wert*	(3) Benzin-äquivalent*	
(4) M 100-Golf Vergaser	16,6	11,9	16,3	14,9	7,9	l/100 km
(5) M 100-Golf Einspritzer	16,8	11,3	15,1	14,4	7,6	l/100 km

(6) * Mischwert bestehend aus 1/3 Stadt, 1/3 90 km/h, 1/3 120 km/h

Key:
1. City
2. Mixed value*
3. Gasoline equivalent*
4. M 100-Golf carburetor
5. M 100-Golf injector
6. *Mixed value consisting of 1/3 city, 1/3 90 km/h, 1/3 120 km/h

Table 4. Test Results of the M 100-Golf with a Carburetor Engine in the ECE Test

	HC_{URAS}	CO	NO_x	
(1) M 100-Golf Vergaser	3.3	35.4	2.5	g/Test
(2) geforderte Grenzwerte	8.5	91.0	10.2	g/Test

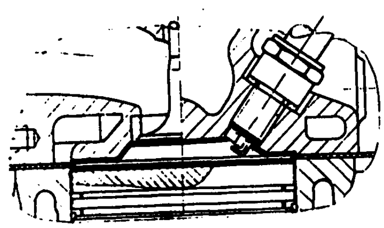
Key:
1. M 100-Golf carburetor
2. Required limits

Table 5. Emission and Consumption Results of U.S. Designs

	(1) Emissionen (US 75-Test)			
	HC	CO	NO_x	
M 100-Rabbit	0.14	0.8	0.32	g/mile
Ethanol-Rabbit	0.30	1.5	0.29	g/mile
(2) geforderte Grenzwerte	0.41	3.4	0.4	g/mile
	(3) Kraftstoffverbrauch (Benzinäquivalent)			
	City	Highway	Combined	
M 100-Rabbit	28.2	36.9	31.5	mpg

Key:
1. Emissions (U.S. 75-Test)
2. Required limits
3. Fuel consumption (gasoline equivalent)

Illustration 2. Combustion chamber design of alcohol engine



12124
CSO: 3102/247

END